

Species, host range, and geographical distribution of powdery mildew fungi in Iran

S.A. KHODAPARAST^{1*} & M. ABBASI²

*Khodaparast@guilan.ac.ir

¹Department of Plant Protection, College of Agriculture, The University of Guilan
Rasht, Iran

²Iranian Research Institute of Plant Protection
Tehran, Iran

Abstract — A comprehensive review of the species, host range and geographical distribution of powdery mildew fungi in Iran is presented. The listed fungi belong to eight teleomorphic genera — *Blumeria* (1 species), *Erysiphe* sect. *Erysiphe* (14 species), *Erysiphe* sect. *Microsphaera* (15 species), *Erysiphe* sect. *Uncinula* (6 species), *Golovinomyces* (9 species), *Leveillula* (14 species), *Neoerysiphe* (2 species), *Phyllactinia* (3 species), *Podosphaera* sect. *Podosphaera* (3 species), *Podosphaera* sect. *Sphaerotheca* (12 species), and *Sawadaea* (2 species) — and one anamorphic genus, *Oidium* (five species). The 528 host plant species reported in the checklist pertain to 287 genera. The complete checklist of fungi is available on http://staff.guilan.ac.ir/staff/users/khodaparastm/fckeditor_repo/file/Checklist.pdf.

Key words — biotrophic fungi, biodiversity, *Erysiphaceae*

Introduction

Fungi belonging to the order *Erysiphales* are widely distributed all over the world and cause powdery mildew diseases on numerous wild as well as cultivated plants. The knowledge of powdery mildew species in particular areas is important for understanding the biology and taxonomy of these fungi as well as for phytopathological purposes. During the past ~150 years, many fungi have been collected in and around Iran, including representatives of the *Erysiphales*. However, powdery mildews have never been extensively studied in Iran, so that information on the species and their host plants is scattered in various plant pathological reports and some general fungal lists (Esfandiari 1946a,b, 1947, 1948, 1951; Eskandari 1964; Petrak 1941, 1949, 1953; Petrak & Esfandiari 1941; Sharif & Ershad 1966; Altman et al. 1972; Ershad 1971, 1995). To our knowledge, Rabenhorst (1871), citing two species of powdery mildew from Iran, was the first to report *Erysiphales* from the country. Some recent

publications include lists of the powdery mildew fungi from Iran, but these have been incomplete and restricted to regional studies (Khodaparast et al. 2000b, 2001; Tajik-Ghanbary et al. 2005; Tavanaei et al. 2005; Pirnia et al. 2007). The aim of this paper is to provide a comprehensive review of the species, host range, and geographical distribution of powdery mildew fungi in Iran.

Materials and methods

Between 2002 and 2007 numerous new collections and herbarium specimens of *Erysiphales* from Iran were examined using light microscopy. In addition, a list of the species, including their host plant species and geographical distributions, were compiled using data from the literatures. The generic taxonomy was based on the new genus concepts introduced by Braun (1999), Braun & Takamatsu (2000), and Braun et al. (2002). Species identification followed Braun (1987, 1995) and recent papers (Khodaparast et al. 2000a, 2002; Shin 2000; Braun et al. 2001, 2006; Takamatsu et al. 2007; Braun & Minnis 2008). Host plant nomenclature follows THE INTERNATIONAL PLANT NAMES INDEX and FLORA EUROPAEA (Anonymous 2008a,b).

Results

TABLE1. Overview of the taxa of the *Erysiphales* and their host plant genera and species reported from Iran

GENUS	NUMBER OF FUNGAL SPECIES	NUMBER OF HOST PLANT GENERA	NUMBER OF HOST PLANT SPECIES
<i>Blumeria</i>	1	21	53
<i>Erysiphe</i> sect. <i>Erysiphe</i>	14	60	92
<i>Erysiphe</i> sect. <i>Uncinula</i>	6	8	15
<i>Erysiphe</i> sect. <i>Microsphaera</i>	15	13	23
<i>Golovinomyces</i>	9	43	61
<i>Leveillula</i>	14	116	187
<i>Neoerysiphe</i>	2	8	10
<i>Phyllactinia</i>	7	23	42
<i>Podosphaera</i> sect. <i>Sphaerotheca</i>	12	28	44
<i>Podosphaera</i> sect. <i>Podosphaera</i>	3	5	10
<i>Sawadaea</i>	2	1	8
<i>Oidium</i>	5	85	96

A total of eight teleomorphic genera and 90 species of the *Erysiphales* were identified in Iran. According to our results these fungi parasitized approximately 528 host plant species in this country. The names of the powdery mildew genera, the number of species per genus, the number of host plant genera and

species are summarized in TABLE 1. The complete alphabetical checklist, which lists all powdery mildew taxa, host plant species, collection sites, and relevant references, can be downloaded from http://staff.guilan.ac.ir/staff/users/khodaparastm/fckeditor_repo/file/Checklist.pdf. The cited 528 host plant species represent 287 genera. It is expected that more collections and further taxonomic studies will substantially increase our knowledge on the presence of these fungi in Iran.

Acknowledgments

The authors greatly appreciate Drs. U. Braun, S. Takamatsu and L. Kiss for their suggestions and comments that improved the manuscript. This work was supported in part by the project number 53 of Deputy of Research and Technology of University of Guilan, Iran.

Literature cited

- Anon. 2008a. The International Plant Names Index. Published on the Internet <http://www.ipni.org> (accessed on January 2008).
- Anon. 2008b. Flora Europaea. Published on the Internet <http://rbg-web2.rbge.org.uk/FE/fe.html>. (accessed on January 2008).
- Altman J, Eslami AK, Vaziri A. 1972. Diseases of crops in the Khuzestan province of southwestern Iran. *Plant Disease Reporter* 56(12): 1067–1069.
- Braun U. 1987. A monograph of the *Erysiphales* (powdery mildews). *Beihefte zur Nowa Hedw.* 89: 1–700.
- Braun U. 1995. The Powdery Mildews (*Erysiphales*) of Europe. Jena, Fisher Verlag, Germany.
- Braun U. 1999. Some critical notes on the classification and the generic concept of the *Erysiphaceae*. *Schlechtendalia* 3: 48–54.
- Braun U, Takamatsu S. 2000. Phylogeny of *Erysiphe*, *Microsphaera*, *Uncinula* (*Erysipheae*) and *Cystotheca*, *Podosphaera*, *Sphaerotheca* (*Cystothecaceae*) inferred from rDNA ITS sequences – some taxonomic consequences. *Schlechtendalia* 4: 1–33.
- Braun U, Cook RT, Inman AJ, Shin HD. 2002. The taxonomy of the powdery mildew fungi. 13–55, in RR Bélanger et al. (eds.). *The powdery mildews, A comprehensive treatise*. The American Phytopathological Society, St. Paul, MN, USA.
- Braun U, Minnis AM. 2008. The nomenclature of *Erysiphe clandestina* (≡ *Uncinula clandestina*) revisited. *Schlechtendalia* 17: 55–57.
- Braun U, Shishkoff N, Takamatsu S. 2001. Phylogeny of *Podosphaera* sect. *Sphaerotheca* subsect. *Magnicellulatae* (*Sphaerotheca fuliginea* auct. s.l.) inferred from rDNA ITS sequences- a taxonomic interpretation. *Schlechtendalia* 7: 45–52.
- Braun U, Takamatsu S, Heluta V, Limkaisang S, Divarangkoon R, Cook R, Boyle H. 2006. Phylogeny and taxonomy of powdery mildew fungi of *Erysiphe* sect. *Uncinula* on *Carpinus* species. *Mycological Progress* 5: 139–153.
- Ershad D. 1971. Contribution to the knowledge of *Erysiphaceae* of Iran. *Iranian Journal of Plant Pathology* 6: 50–59.
- Ershad D. 1995. *Fungi of Iran*. Publication number 10. Plant Pest and Disease Research Institute, Tehran.
- Esfandiari E. 1946a. Contribution à l' étude de la mycoflore de Iran. Department general de la protection des plantes, Tehran.

- Esfandiari E. 1946b. Deuxieme liste des fungi ramassés en Iran. *Applied Entomology and Phytopathology* 2:10–16.
- Esfandiari E. 1947. Les maladies des plantes cultivées et des arbers fruitiers des regions subtropicales du nord de l' Iran. *Applied Entomology and Phytopathology* 5:1–21.
- Esfandiari E. 1948. Troisième liste des fungi ramssés en Iran. *Applied Entomology and Phytopathology* 8: 1–15.
- Esfandiari E. 1951. Quatrième liste de fungi de l' Iran. *Applied Entomology and Phytopathology* 12–13: 1–43.
- Eskandari F. 1964. A list of plant diseases from northern and northwestern parts of Iran. *Iranian Journal of Plant Pathology* 1(5): 9–15.
- Khodaparast SA, Braun U, Hamzeh Zarghani H. 2000a. *Leveillula rubiae*, a new species from Iran. *Schlechtendalia* 4: 49–51.
- Khodaparast SA, Hedjaroude GA, Ershad D, Zad J, Termeh F. 2000b. A Study on the identification of *Erysiphaceae* in Guilan province, Iran (I). *Rostaniha* 1: 53–63.
- Khodaparast SA, Hedjaroude GA, Ershad D, Zad J, Termeh F, Mousavi M. 2001. A Study on the identification of *Erysiphaceae* in Guilan province, Iran (II). *Rostaniha* 2: 45–52.
- Khodaparast SA, Hedjaroude GA, Takamatsu S, Braun U. 2002. Tree new species of the genus *Leveillula* from Iran. *Mycoscience* 43: 459–462.
- Petrak F. 1941. Beiträge zur Kenntnis der Orientalischen Pilzflora. *Annalen des (K.K.) Naturhistorischen (Hof) Museums. Wien.* 52:301-396.
- Petrak F. 1949. Beiträge zur Plizflora Irans. *Sydowia* 3: 268-332.
- Petrak F. 1953. Beiträge zur Kenntnis der Plizflora Irans. *Sydowia* 7: 50-78..
- Petrak F, Esfandiari E. 1941. Beiträge zur Kenntnis der iranischen Pilzflora. *Annales Mycologici* 39: 204-228.
- Pirnia M, Khodaparast SA, Abbasi M. 2007. Study on the genus *Phyllactinia* (*Erysiphaceae*) in Iran. *Iranian Journal of Plant Pathology* 43(4): 445–464.
- Rabenhorst GL. 1871. Übersicht der von Herrn Prof. Dr. Haussknecht im Orient gesammelten Kryptogamen. *Hedwigia* 10: 17–27.
- Sharif G, Ershad D. 1966. A list of fungi on cultivated plants, shrubs and trees of Iran. Ministry of Agriculture, Plant Pest and Diseases Research Institute, Evin, Tehran.
- Shin HD. 2000. *Erysiphaceae* of Korea. National Institute of Agricultural Science and Technology Suwon, Korea.
- Tajik-Ghanbary MA, Hedjaroude GA, Ershad D, Termeh F, Mousavi M. 2005. Identification of fungi belonging to *Erysiphaceae* in Golestan National park. *Khazar Agricultural and Bioresource Research* 4: 63–71.
- Takamatsu S, Braun U, Limkaisang S, Kom-Un S, Sato Y, Cunnington JH. 2007. Phylogeny and taxonomy of the oak powdery mildew *Erysiphe alphitoides* sensu lato. *Mycological Research* 111: 809–826.
- Tavanaei G, Fazlali Y, Khodaparast SA. 2005. Introduction of the fungi causing powdery mildews on oak trees in Arasbaran forests. *Iranian Journal of Forest and Range Protection Research* 3(1): 69–83.